much notice, such as the honeysuckle, (*Bunksia Australis*), and woods of the same class, which require an investigation above what is here intended. But it may be seen by reference to the Sydney Exhibition Catalogue. It is shown there are 245 varieties of native woods, collected from the southern districts. Of these—

22 produce excellent hard wood
12 " wood suitable for turning.
16 " wood of considerable variety for cabinet-making.

XIII.

MICROSCOPIC INVESTIGATION, AND SOME MINOR DETAILS OF MANIPULATION.

BY WILLIAM SYDNEY GIBBONS.

READ MAY 3, 1855.

IMPORTANT and interesting as doubtless all will admit the study of micrography to be, some apology may appear necessary for the selection of a subject so limited in its interest as that I have chosen for the present paper. The details I have to communicate are so apparently trivial, that few, but those who are engaged in the prosecution of microscopic investigation, will be likely to enter into them with me. They are merely points of manipulation—the results of my own experience, and only mentioned inasmuch as they differ from the operations of others. It frequently happens in a place like this colony, where the ordinary appliances of science are of difficult attainment, that the student has to resort to expedients varying somewhat from the routine of English and Foreign observers. It is chiefly of such expedients and of the peculiar contrivances for mounting microscopic preparations which have from time to time occurred to me that I have now to speak.

To introduce and recommend the study of Microscopy or Micrography to those who have not hitherto entered upon it, I may be allowed to make a few observations as to its value and importance, and as to the modes in which the present may be followed. As the use of the microscope and the arts of preparation are much better set forth in the valuable text-books of Quekett, Hogg, Pritchard, and others, than I can hope to do in a casual paper, I do not propose to enter at any length into general descriptions. The microscope, formerly popularly regarded only as a costly philosophical toy, and used by scientific men only for purposes of limited and perhaps questionable importance, has of late years become the inseparable companion of the investigator of almost every branch of science.

Not a single department of natural history, taking that title in its widest sense, is independent of the microscope. By its aid the geologist discovers traces of old organisms, which, without it, must have remained sealed; he employs it in his search for coal and for the estimation of its value when found. The mineralogist is frequently indebted to it for the comparison of crystals and the examination of minerals generally. Its uses to the zoologist are beyond enumeration; the structures of bones and teeth have alone sufficed to refer a fragmentary fossil to its proper position in the scale of nature; a knowledge of the varied organisms of the other animals has often served to distinguish them, when necessary, from each other, and from those of man. The botanist would be totally at a loss without the means of examining the form and arrangement of the minuter parts of plants; he needs also to identify woods, to compare recent with fossil plants, and to determine a multitude of points that have entered in a commercial as well as scientific point of view. The chemist uses his microscope to examine the results of minute analyses, to watch changes that follow the use of re-agents, and to follow out successfully the study of crystallography and inorganic structure. In medical practice occasions for the use of the microscope are of constant occurrence; and the study of anatomy, physiology, and pathology, would be incomplete without recourse to it. The different appearances presented by portions of the animal economy under various conditions of health and disease, the indications afforded by the secretions, the fluctuating characteristics of the blood itself, and the evidences which diagnoses based on these observations will afford of the treatment and remedies which the system requires, are among the uses of the microscope to the medical man. And in cases in which a life has depended upon its decision, it has frequently been enabled to pronounce with absolute certainty upon the guilt or innocence of a prisoner charged with a capital offence. Harvey's great discovery of the circulation of the blood received conclusive support from the observations of Malpighi who first witnessed the beautiful phenomenon.

By the microscope the purity of many articles used in food and medicine, and the genuineness of textile fibres and of materials, and in the arts, may frequently be tested, and adulteration or substitution detected. The commission instituted by the *Lancet*, for the purpose of examining several articles of extensive domestic use, frequently relied entirely on the observation of form and structure. The farinæ of different plants may be distinguished by the peculiarities of the starch grains; drugs, upon the purity of which so much of our health depends, are amenable to the same test; in short, greater difficulty would be found in selecting a subject of study in which the aid of microscopy is not valuable than in enumerating its varied applications. I have selected for the inspection of the members present a number of objects illustrative of the preceding observations, and it will be a source of great gratulation to me if I succeed in alluring to this most fascinating and useful pursuit any of my hearers.

A brief notice of the ordinary mode in which objects are prepared for observation and preservation, will serve to explain the comparatively trivial details that have suggested the writing of the present paper. It is of the first necessity that the delicate structures be securely protected from injury. This is generally effected by enclosing them between two plates of glass. The mode in which they are so mounted varies with the nature of the object, and the practice of the operator. Opaque objects are frequently mounted dry, and without covering. The best mode of mounting for these is to attach them to a dark ground on glass slips of standard size. Professor Quekett and other writers have recommended various forms of cell for this purpose; the use of small pill boxes presents the advantage of the protection which the covers afford. In the absence of these I have made a very useful cell of millboard. I punch in a sheet of millboard a series of holes of the size of the inside of the intended cell; I then paste a sheet of stout paper on one side of the sheet, and paint the whole with a pigment composed of lampblack and size, which I find of constant use: when the whole is dry I cut out the cells with a large punch.

Cells made in this way are readily and cheaply obtained, the materials are always at hand, and they answer for various kinds of objects. For those which it is intended to show by reflected light, they need no further preparation; they are simply gummed to the glass flat, and the object is attached to the bottom by the same cement. They have also this advantage—that they may be made of any required depth, and, if desired, a certain portion of one side may be cut away to admit a greater amount of light on any one part of the object, while the general protection remains; they may also be made of any size and form that is desired. If the black pigment be made with strong size, the cells will be impervious to balsam and oily fluids, if not to spirit, and the substitution of varnish for size will qualify them for the reception of the other preservative fluids. The covers may then be attached by means of gold size or any other of the usual cements.

The use of gold size presents so many advantages that I prefer it in all cases where it is admissible. I find it advantageous to paint the rims of the cells with gold size some time before using them, and to allow them to dry; this proceeding greatly facilitates the attachment of the cover, a matter of some importance when mounting in fluid: it also very much lessens the risk of the gold size escaping into the cell. I have also made some excellent cells of gutta percha and lead, which I submit for the inspection of the meeting. I anticipate being able to make some cells on Darker's plan out of the latter material by means of dies. To make built cells and troughs I generally use Canada balsam, and employ a rather high degree of heat to give it a good hold of the glass. I have troughs made in this way that have lasted for years.

For cutting the slips of glass, or flats, as they are technically termed, I find it convenient in the absence of a cutting board (and I am not sure that it is not the better plan) to rule a sheet of paper with lines dividing the whole surface at compartments of the required size; by this plan glass of irregular form may be worked up with great exactness. While on the subject of glass cutting, which, trivial as it may appear, is of no small importance, especially as we have no Ross or Topping to go to for a gross of patent *flats* or an ounce of *thin covers* when we want them, I may be allowed to mention a mode of cutting the covers without risk of breakage. It is simply to lay the work on a slab of plate glass, wetted. The water affords support to the fragile material, and binds it to its position, so that the operation otherwise difficult, is easily performed. I mention this not as an original idea, but because it is mentioned by but few writers, and it is possible that others may experience the same difficulty that I frequently laboured under until I met with the suggestion. Those who are not operators will see the value of even this simple artifice when they are told that the material to be cut is glass of the average thickness of a hundredth of an inch,—and unannealed.

Writers and operators are divided as to the advisability of using turpentine, as a diluent to Canada balsam, in making microscopic preparations. It is often objected, that oily globules separate themselves from the turpentine after a few weeks. I cannot say that I have found this difficulty; some of the preparations now on the table have been made for three or four years, with turpentine in equal proportion to the balsam, and they are yet clear and perfect. I frequently keep a mixture of balsam and turpentine ready for mounting; it requires a gentle continued heat to evaporate the volatile matter, but I am of opinion that the preparation is more permanent and less likely to split away on receiving a jar, than when balsam alone is used. In the latter case, I always touch the heated balsam on the flat with a single drop of turpentine, to clear it of bubbles before placing the object. Sometimes I have used the previously noticed dilute balsam cold to mount the object, and have sealed it by the application of heat after the cover has been put on. For objects in which it is desirable to retain the air, as the tracheæ of insects, and indeed, in injected pulmonary organs generally, it is advisable to compress the object by the aid of water or spirit, and to let it dry. The balsam should then be heated, and allowed to become slightly cool, and the object laid upon it and immediately covered, the cover being warmed. The tracheæ of a musquito, now on the table, was mounted in that way. Several of the scales and wings were mounted on dilute balsam, as above described. I have found the wooden clips, imported under the unpretending title of American spring clothes-pegs, invaluable as compressors, both for flattening objects and for compressing them when mounted, so as to bring the covers fairly down upon the object, and to ensure perfect union between the glasses. The clips are also useful in building cells, and in a multitude of other operations; used in pairs one at each end of a pair of flats, they serve to replace the ordinary compressors for temporary observations.

Some years since I made some experiments in the use of the air-pump in making microscopic preparations, believing that it had not then attracted the attention of operators. Since that time, I found in a recent work an account of some uses that had been made of that instrument, but that which I found most advantageous was not mentioned and appeared to have escaped the experimenter; while that most dwelt upon in the work in question, is one that I abandoned as unavailing, nor have I seen occasion to change the opinion. The operator quoted immerses the objects in balsam, and then places them on a dry hot bath under the receiver of an air pump; the air is supposed to be extracted by this process from the minute pores or cells, and its place supplied by the balsam. I found, however, that in the majority of cases the viscidity of the balsam retains the bubbles of air even when they escape from the object, and that many of them return to their original positions on the restoration of atmospheric pressure. The plan I recommend as preferable, is to immerse the object in a bath of turpentine, and exhaust it before applying the balsam. The limpidity of the turpentine allows the free escape of air, and when the object is removed from the bath to be mounted, the balsam then blends with the turpentine, and follows it into minute cavities whither it could not alone have penetrated.

Before quitting the subject of mounting, I may mention that I have found the common balsam of copaiba a useful medium in which to preserve objects of a delicate character, which it is not desired to mount immediately. I have used it cold, and have mounted the objects in it temporarily, between two plates of glass; and have transmitted them by post and otherwise to distant parts of the country in perfect safety; objects so prepared may at once be mounted in Canada balsam without further preparation. The advantage derived from the use of copaiba is that it is not so viscid, and does not dry so rapidly as the other balsam, while its refracting properties are so little inferior that no detriment results from its use.

The next point on which I have to make an observation that I believe to be original, is the mode of killing insects and other small animals. A paper recently read to the British Association mentions that cyanide of potassium has been employed for this purpose. I have had occasion to make some rather large quantities of this salt for other processes, and contemplated the employment of it as a means of destruction, for which its active poisonous property eventually fits it, but I was so well satisfied with other plans, that I have not yet tried it. I find that immersion in turpentine kills small insects almost instantaneously, and has the great advantage of making them protrude their probosces, lancets, and other organs—a very desirable effect; they are also more readily saturated and rendered diaphanous than after they have been allowed to harden. If it is intended to disect the internal organs, this plan will not do, and Swammerdam's plan of suffocating the animals in spirits will be found almost as rapid, and much more suitable. But the agent I most incline to in cases when turpentine is inadmissible, both on the ground of humanity, as causing speedy death, and for its preservative quality which renders it suitable for the cabinet, is creasote. If the mouth and spiracles be touched with a pencil dipped in it, the creatures most tenacious of life, soon yield to its influence. The use of spirit to suffocate the animal, and the exhibition of creasote to its mouth,

&c., both present the advantage of hardening the viscera, which is very desirable, as it tends materially to assist the process of dissection—at least so long as the albuminous portions are not so much coagulated as to make the delicate organs cling together. There is risk, however, that cyanide of potassium would corrode delicate organisms, and thus be productive of mischief. Small soft-bodied animals are, by soaking in spirit, rendered less liable to injury in the process of compression.

For the purpose of collecting aquatic animalcules, I use, in preference to any kind of net, those on the table. They consist of stout tin hoops, about four inches diameter and one and a half deep, nested for stowage. Muslin of different degrees of fineness is strained over one opening of the hoop, and a screw is attached by its head to the rim. The net is thus portable, and is screwed into a hole in the end of a walking-stick, or what is better a fishing-rod. I find that for most purposes the fabric called bobbinet answers very well, and catches creatures much smaller than its own meshes, while the free escape of water through the openings prevents their being washed out, as they frequently are in withdrawing the net from the surface. If the stick have a spike at the other end it may be stuck in the ground, and those animals that are visible to the naked eye leisurely picked out, with a small thin spoon or palette-knife, and transferred to bottles, care being taken that the more voracious ones be separated from their prey; while the thick residuum, containing infusoria, &c., may be ladled up or strained off into its appropriate vessel. On arriving home the contents of the bottles are poured into one of the finer nets, which is placed in a saucer of water. The drafting net is then lifted up out of the water, and a final classification may be made. To catch individual creatures that are too large for a fishing-tube, a small spoon-net, made of slips of thin metal, bent into the form of a spoon, with a large hole punched out of the bowl, and muslin cemented to the rim, will be found convenient.

This form of net is free from the inconvenience of loose parts of material, in which choice specimens may be confused and lost.

Before concluding this paper, I may mention a very useful cement, for fine work, which was communicated to me by my friend Mr. Capewell, of Ballan. Canada balsam is heated and evaporated to dryness, and the residual resin dissolved in ether. This cement dries as rapidly as collodion, is perfectly limpid, and does not coagulate.

I hope soon to submit to the Institute a section cutting machine, which I am constructing on a plan different to any I have yet met with, and presenting, as I fancy, some conveniences. I have here some sections cut with it in its present state, but it is not yet mounted.

Whatever value may be attached to the observations I have here made, and to the new modes of operation that I have recommended, I offer them in the hope that other observers will similarly favour us with the result of their experience. Many of the contrivances mentioned were devised long since in the absence of other appliances, and when text-books were scarce here, and there were few collaborateurs within my acquaintance whom I could consult. Thrown thus upon my own resources, I had to contend with many rough substitutes, the inconvenience of which compelled the invention of some more suitable contrivances. Those who are engaged in similar pursuits will readily enter into these observations, and will, I trust in like manner, communicate information as to their modes of action, as by entering into these particular details, results of general importance are attained. To such persons no apology will be necessary for the matter of these notes, whatever defects there may be in the manner, and I hope that those to whom the minute and apparently trivial details were dull and dry, will find subjects of interest in the resulting specimens which I have the pleasure to submit to them.